

well below freezing, snow and ice did not form on outdoor surfaces near where commercial plants discharged waste products resulting from alcohol distillation processes. Thus, after experimentation, he proposed the use of these distillation byproducts as alternatives to chloride salts as anti-freezing and deicing agents. A description of his experimentation with these compounds is found in U.S. Pat. No. 4,676,918, issued June 30, 1987.

Later proposals seeking to diversify from Dr. Toth's work propose the use of similar types of byproducts as anti-freezing or deicing agents. For example, U.S. Pat. Nos. 5,709,813, 5,709,812, and 5,635,101, all to Janke et al., propose the use of the waste byproducts of the wet corn milling, wine, and cheese-making processes as anti-freezing and deicing agents. While the compositions forming these byproducts serve as effective anti-freezing and deicing agents, several limitations remain.

First, many of the compositions proposed in these patents take on the consistency of "thick molasses" at low temperatures and at extremely low temperatures (e.g. below 0° F), become thick and putty-like. In this form, the compounds can only be effectively spread onto surfaces for use if first placed in solution with water or other compounds, such as known prior art chemical deicing agents. While it is feasible to do so to form an improved anti-freezing/deicing solution, it has been observed that such a solution continues to be high in the concentration of suspended solids and, thus, tends to clog conventional spraying or spreading devices. Such clogging can result in poor or inadequate spreading over the surface/object to be treated and thus ineffective performance. Still further, significant downtime may be necessary to clean the sprayers used to apply the composition. This costly and labor intensive operation is often quite difficult when out on the job away from repair facilities and appropriate equipment for such a purpose. Further, it can be particularly detrimental when inclement weather, such as when snow storms or severe temperature drops accompanied by precipitation, are quickly approaching or ongoing.

Another difficulty is that the compositions resulting from the fermentation or cheese-making processes are often biologically reactive. Thus, if the right conditions are presented, the organisms responsible for fermentation will continue

to "grow," even after application. For example, if a first layer of a fermentation byproduct containing yeast or other active cultures is applied to a roadway, and then a second application is made, air becomes entrained between these layers.

With the right amount of light, heat, and moisture, the yeast will continue the

- 5 fermentation process, which will yield strong odors and foam. In certain applications, such as where these compounds are used on roadways in residential neighborhoods, this unpleasant and unsightly mess may be tracked into garages and homes making these compositions totally unacceptable for use.

- Finally, a frequent observation is that distillation and fermentation
10 byproducts have an unpleasant odor. The odor is generally described as being similar to that associated with a feed lot on a farm. While this may be acceptable when such byproducts are used on rural highways or aggregate stockpiles in industrial settings, most urban residents are not accustomed to their streets smelling like fermenting silage and would not be willing to accept living with this
15 odor as a trade-off for snow and ice-free roadways.

- Thus, a need is identified for an improved anti-freezing and deicing composition that overcomes the above-described limitations of the prior art. The composition would preferably be readily available at a low cost, such as is the case with byproducts of widely used commercial processes, and would be ready for use
20 in conventional devices such as sprayers without any additional mixing or processing. The composition would be non-corrosive and preferably would also inhibit corrosion when mixed with prior art chemical anti-freezing or deicing agents. Overall, the composition would be environmentally friendly and, thus, could be applied without harming plants or contaminating the ground or surface
25 water.

SUMMARY OF THE INVENTION

- Accordingly, it is a primary objective of the present invention to provide an anti-freezing and deicing composition. Preferably, the composition is readily
30 available at a low cost, is effective at temperatures well below freezing, is suitable for use in conventional sprayers or like devices without modification or additional processing, and is non-corrosive, biologically inert, and non-offensively smelling.

In preferred embodiments, an important objective of the present invention is to provide an anti-freezing and deicing composition that is readily soluble and miscible with water and other common chemical anti-freezing or deicing agents, such as chloride salts, while retaining the desired anti-freezing and deicing

5 properties.

An additional objective of the present invention is to provide in preferred embodiments an anti-freezing and deicing composition that is effective when admixed with anti-skid agents for use on surfaces such as roadways in anticipation of inclement weather to prevent ice and snow formation and improve traction.

10 Still a further objective of the present invention is to provide in preferred embodiments an anti-freezing composition that may be applied on aggregate stockpiles in anticipation of low temperatures to keep the aggregate materials from freezing together.

Another important objective of the present invention is to provide in
15 preferred embodiments an anti-freezing and deicing composition that provides residual effects for an extended period of time following an initial application, thereby preventing any significant amount of ice or snow pack from reforming on treated surfaces.

Yet another objective of the present invention is to provide in preferred
20 embodiments an improved method of preventing ice and snow accumulation and/or deicing and cleaning surfaces of accumulated snow and ice in a more convenient, cost effective, reliable and efficient manner.

Additional objectives, advantages and other novel features of the invention will be set forth in part in the description that follows and in part will become
25 apparent to those skilled in the art upon examination of the following or may be learned with the practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

To achieve the foregoing and other objectives, and in accordance with the
30 purposes of the present invention as described herein, an anti-freezing and deicing composition is disclosed. As will be appreciated from reviewing the description which follows, the composition provides a readily available, low-cost, non-

corrosive solution to the problem of both preventing the formation of and removing ice and snow from surfaces, such as roadways, and on other objects, such as aggregate stockpiles. Advantageously, the composition of the present invention overcomes the limitations of prior art proposals by working in

5 conventional sprayers or spreading equipment without the need for either equipment modification or additional mixing or processing, without giving off an unpleasant odor, without being biologically reactive, and without harming the environment. The compositions can be applied to various surfaces including, without limitation, roads, walkways, bridges, and machine surfaces (*e.g.*, an

10 airplane wing or a tractor).

The anti-freezing and deicing composition of the present invention is a waste product of the process used to remove sugar from sugar beet or cane molasses or from other types of molasses (*e.g.*, sorghum or citrus molasses). Normally, this byproduct, which is commonly referred to as "desugared sugar beet

15 molasses" or "desugared sugar cane molasses." More generally, the product formed upon desugaring a molasses is known as "desugared molasses," a solution which used as animal feed or simply discarded after all useful sugar is removed through processes well known in the art and described below. However, it has been discovered that the desugared molasses is highly effective as an anti-freezing

20 and deicing agent that is suitable for use at temperatures well below the freezing point of water, while overcoming many of the disadvantages of prior art anti-freezing or deicing agents. For example, desugared molasses is ready for use in conventional sprayers as delivered from the manufacturer without additional processing. Moreover, the desugared molasses is less prone to biological upset, as

25 it contains no alcohols, or other fermentation byproducts including yeasts and any other microorganisms associated with the fermentation process. Another advantage is that the solution has a non-offensive, light chocolate odor, that makes it acceptable for use in residential settings.

In accordance with another important feature of the proposed anti-freezing

30 and deicing composition of the present invention, the desugared molasses is readily soluble and miscible with other types of known chemical anti-freezing or deicing agents without affecting the basic properties thereof. Examples of such

agents include sodium formate, calcium magnesium acetate, potassium acetate, ethylene glycol, di-ethylene glycol, or chloride salts, such as calcium chloride, magnesium chloride, or sodium chloride (preferably in the form of rock salt). As described further below, the desugared molasses in solution improves the deicing properties of these prior art chemical deicers. As a result, lower concentrations of these chemical deicers are effective for their intended purpose. Consequently, the impact of these chemical deicers on the environment and any corrosive effects thereof are advantageously reduced.

It should be appreciated that the use of the term deicing connotes that the desugared molasses is effective to remove ice (by "ice" also including snow) already accumulated on surfaces, such as concrete, pavement, aggregate stockpiles, or the like. However, it must also be appreciated that the desugared molasses is also quite useful to prevent the formation or accumulation of snow or ice. For example, in anticipation of a storm or other type of inclement weather, the desugared molasses can be applied to prevent snow or water from freezing on the roadways. Even if large amounts of snow or ice are deposited on the road, the desugared molasses prevents the ice from sheeting or the snow from becoming packed down, which advantageously allows road crews to remove the accumulation in an expeditious manner. A residual effect is also observed, such that surfaces where the desugared molasses is applied tend to prevent the formation of solid ice or snow pack thereon for an extended period of time following an initial application.

In accordance with preferred embodiments of the invention, a deicing composition is provided (it should be appreciated that the composition also is suitable as an anti-icing composition). The composition includes desugared molasses and a second deicing component, which second component may be a glycol, such as ethylene glycol or di-ethylene glycol, or may be a salt, such as one or more of the sodium, calcium, magnesium, and potassium salts of acetate, chloride, and formate. Other soluble salts may be employed, *e.g.*, soluble potassium salts. The second component may be present in an amount ranging from about 5% to about 80% by dry weight, preferably about 10% to about 60%

by dry weight (in the case of a glycol, "dry" meaning weight in the absence of water).

When using the desugared molasses in accordance with the present invention on roadways, it is also possible to admix the desugared molasses with
5 anti-skid materials such as sand or cinders to improve traction. This can be done both when applying the desugared molasses in anticipation of a snow or ice accumulation or when the desugared molasses is used to remove ice or snow that has already accumulated on roadway surfaces or the like.

In accordance with another important aspect of the invention, the desugared
10 molasses composition is non-corrosive and environmentally friendly. Thus, it will not harm vehicles or other outdoor structures fabricated from typically corrosion prone metals, nor will it promote spalling or other damage to concrete or pavement. For instance, through experimentation, it was discovered that when the desugared sugar beet molasses is mixed with typically corrosive anti-freezing and
15 deicing compounds, such as chloride salts, the beet molasses of the present invention actually serves to reduce or eliminate the corrosiveness of the solution.

Still other objects of the present invention will become apparent to those skilled in this art from the following description wherein there is shown and described a preferred embodiment of this invention. As it will be realized, the
20 invention is capable of other different embodiments and its several details are capable of modification in various, obvious aspects all without departing from the invention.

DETAILED DESCRIPTION OF THE INVENTION

25 The anti-freezing and deicing composition of the present invention is formed using a waste product of the process for removing sugar from sugar beet molasses, also known as desugared sugar beet molasses, or from sugar cane, in which case the product is known as desugared sugar cane molasses. With respect to the former desugared molasses, as is well-known in the art, sugar beets are used
30 to produce commercial grade sugar that serves as a substitute for the often more expensive cane sugar. The older of two most widely used processes of removing sugar from sugar beets involves cleaning the beets and slicing them into thin chips.

The sliced beets are then subjected to a sugar extraction process whereby hot water is passed over the beets for approximately one hour. This process removes most, but not all, of the sugar from the beets in the form of beet "juice." The beets are then pressed in screw presses to remove the remaining sugar containing juice

5 therefrom. The juice is then subjected to a process called carbonation, where small clumps of chalk are provided in the juice to filter out any non-sugars. The chalk is then filtered from the juice, which is evaporated to form a syrup. The syrup is then boiled until sugar crystals form therein. Once the crystals form, the resulting mixture is centrifuged to separate the crystals from the remaining liquor.

10 The crystals become commercial grade sugar; the liquor is the desugared sugar beet molasses that forms the anti-freezing and deicing composition of the present invention.

A second, more modern process for obtaining desugared sugar beet molasses, known as the Steffen process, is described in U.S. Pat. No. 5,639,319 to

15 Daly, which proposes the use of desugared sugar beet molasses as a tire ballast. The disclosure of this patent as it relates to the production of desugared sugar beet molasses and the properties and various suppliers thereof is incorporated herein by reference. It should be appreciated that the manner of producing the desugared sugar beet molasses is not critical to the present invention, although it is observed

20 that sugar beet molasses which is a byproduct of the Steffen process generally exhibits slightly better anti-freezing and deicing properties relative to the desugared sugar beet molasses formed using other conventional methods. However, it should be realized that both will generally serve equally well for purposes of the composition of the present invention. With respect to desugared

25 sugar cane molasses, this product may be obtained via any method or process known in the art or otherwise found to be suitable. Other types of molasses may be obtained via any method known in the art or found to be suitable.

Experimentation revealed that the resultant desugared sugar beet molasses from the desugaring process is an excellent anti-freezing and deicing composition

30 that provides several benefits over known compositions previously proposed for this purpose. The desugared molasses is approximately 60 to 80% suspended solids, often 60 to 75% suspended solids. Thus, it can be pumped or sprayed using

existing equipment without mixture with additional water or other thinners. Additionally, the desugared sugar beet molasses has a low freezing point and is flowable at low temperatures (approximately 150 cps at -30° F). This means that it can be sprayed for application at temperatures well below freezing. Desugared
5 cane sugar molasses also has a low freezing point and is flowable at low temperatures, and is also suitable for use in cold climate areas. Thus, the present invention is particularly useful in cold climate areas where the temperature is too low for brine solutions to effectively provide deicing. The molasses is also environmentally friendly, is not biologically reactive, and is both non-corrosive
10 and a corrosion inhibitor.

Another advantage of the invention is that the desugared molasses can be mixed with commercially available chemical anti-freezing or deicing agents without inhibiting the beneficial properties thereof. While higher concentrations are possible, generally the maximum percent by weight of the deicing agents used
15 are: sodium formate 55%, calcium magnesium acetate 50%, potassium acetate 50%, ethylene glycol 70%, di-ethylene glycol 70%, sodium chloride 35%, calcium chloride 45%, magnesium chloride 40% and potassium chloride 42%.

Another useful embodiment of the present invention is a composition comprising between substantially 60 to 80%, preferably about 60% to 75% of
20 solids by weight desugared molasses added at 8 to 10 gallons per ton of rock salt. Water may be added to all embodiments as desired or as necessary to improve spraying performance.

Still a further advantage is that anti-skid agents can be mixed with the molasses to improve roadway traction. Examples of such anti-skid materials
25 include sand, gravel, cinders, limestone aggregate, fly ash, river rock or the like and mixtures thereof. It is contemplated that the application of such a mixture may occur prior to the inclement weather, which allows the solution to not only assist in preventing roadway freeze-overs, but also to improve roadway traction. However, it is within the broadest aspects of the invention for the composition of
30 the present invention to be applied to existing patches of snow or ice to act as a deicing agent.

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- The composition is applied to a surface in any amount effective for its intended purpose, *i.e.*, as a deicing agent or as an anti-icing agent. The exact amounts applied will be determined by persons of skill in the art, depending on the exact composition chosen. The composition may be "applied" by applying the
- 5 components separately, such as by first applying salt and then applying desugared sugar beet molasses and optionally other components such as the anti-skid agent.

The typical composition of the desugared sugar beet molasses used in the present invention is as follows (all measurements are approximate):

Item	Content
Moisture	40%
Fructose Polymers	15%
Amino Acid Protein Polymers	12%
Other Carbohydrates, Starches and Polymers	17%
Potassium	9%
Sodium	3%
Chlorine	1%
Other Ash/Calcium Oxide	3%

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Other physical characteristics include:

Weight	10.7 pounds/gallon
PH	9-10
Freezing Point	<-30° F
Boiling Point	212° F
Viscosity	150 cps at -30° F
Color	dark brown
Odor	chocolate

- The following detailed examples illustrate experiments which demonstrate
- 15 the improved properties and characteristics of the compositions of the present invention. These examples are provided for purposes of illustration only and are not intended to be limiting.

EXAMPLE 1

On concrete pavement at an ambient temperature of between 16 and 24° F, four different solutions were applied to an accumulation of between 1/4 to 1" of ice and snow. After twenty minutes, the results were as follows:

Application Rate	Composition	Observations
1-2 oz./sq. yd.	Desugared sugar beet molasses alone (60 to 65% solids)	Performed very well; melted snow and ice and continued to move laterally; moved underneath surface of snow
1-2 oz./sq. yd.	70% desugared sugar beet molasses (60 to 65% solids by weight) mixed with 30% magnesium chloride (30% solids by weight)	Very good results; improved flow and melted more from the top of the ice downward to underneath the surface
2.3-4 oz./sq. yd.	Desugared sugar beet molasses (60 to 65% solids by weight) mixed with rock salt (3 oz. molasses/5 lbs. salt)	Very good results; spread at a fast rate
1-2 oz./sq. yd.	40% desugared sugar beet molasses (60 to 65% solids by weight) mixed with 50% of a 30% solids by weight magnesium chloride solution and 10% water by volume	Excellent results; no solids formed in solution, which avoided clogging the spray nozzles

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It should also be noted that for several hours prior to application, the above solutions were maintained at the ambient temperature, yet no flow problems were observed using conventional sprayers.

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EXAMPLE 2

The corrosiveness of a desugared sugar beet solution was tested by dipping a mild steel nail in the solution for three months. No corrosion on the nail was observed.

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EXAMPLE 3

Three ounces of desugared sugar beet molasses having between 60 to 65% suspended solid are mixed in a mixing vessel with 5 lbs of sodium chloride and

spread over a surface to remove snow and ice by melting which equates to 9.3 gallons per ton of rock salt.

EXAMPLE 4

- 5 A deicing composition is made using 8 gallons of desugared sugar beet molasses per ton of rock salt.

EXAMPLE 5

- 10 A solution of desugared cane sugar molasses, 75% by weight, and sodium chloride, 25% by weight, is prepared.

EXAMPLE 6

- 15 A deicing solution is made by mixing 1 liter of cane sugar molasses (solids content ranging from 60 to 75%) and 1 liter of a sodium chloride brine (23% dry salt).

- 20 The foregoing description of the anti-freezing and deicing composition of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. For example, the desugared sugar beet molasses doesn't need to be mixed with the deicer component or anti-skid agent prior to application to the surface being treated. The desugared sugar beet molasses may be applied to the surface separately either before or after treatment of that surface with a deicer and/or anti-skid agent of a type known in the art.

- 25 All references cited herein and also U.S. Patent 6,080,330 are hereby incorporated by reference in their entireties.